the first protrusion and the second protrusion are the same size.

Preferably, an insulating material may be deposited on or an insulation layer may be attached to an inner area of the upper surface of the first electrode, which is inside of the first protrusion.

Brief Description of the Drawings

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a partial cross-sectional view of an electrode for dry etching a semiconductor wafer in accordance with the present invention;

Fig. 2 is a schematic view illustrating the etching of the upper and the side surfaces of a semiconductor wafer using the electrode of the present invention;

Fig. 3 is a schematic view illustrating the etching of the lower and the side surfaces of the semiconductor wafer using the electrode of the present invention;

Fig. 4 is a cross-sectional view of a dry etching device provided with the electrode of the present invention;

Fig. 5 is a side view of semiconductor wafer, on which multiple layers are deposited;

Fig. 6 is a schematic view illustrating the deposition of foreign materials on the semiconductor wafer by equipment.

Figs. 7a to 7e are cross-sectional views illustrating a process for removing a nitride layer using a conventional wet etching;

Figs. 8a to 8e are cross-sectional views illustrating a process for removing a poly-silicon layer using a conventional dry etching; and

Fig. 9 is a schematic view illustrating the etching of a semiconductor wafer using a conventional electrode.

Best Mode for Carrying Out the Invention

Fig. 1 is a partial cross-sectional view of an electrode for dry etching a semiconductor wafer in accordance with the present invention. The electrode of the present invention comprises a pair of electrodes, i.e., a first electrode 10 and a second electrode 20. The first electrode 10 and the second electrode 20 are means for generating plasma for removing foreign materials deposited and accumulated on the edge of the semiconductor wafer.

Herein, the first electrode 10 is used as an anode and the second electrode 20 is used as a cathode. However, the first electrode 10 may be used as a cathode and the second electrode 20 may be used as an anode.

The same as the conventional electrode, the first electrode 10 is shaped as a flat circle. A ring-shaped first protrusion 10a is formed on the bottom surface of the first electrode 10. A gas inlet hole 10b is formed between the first protrusion 10a and the circumference of the first electrode 10. The gas inlet hole 10b serves to introduce a reactive gas for generating plasma into a vacuum chamber (not shown), in which the first electrode 10 and the second electrode 20 are formed.

The second electrode 20 is also shaped as a flat circle having the same diameter of that of the first electrode 10. An opening 20a is formed on the center of the second electrode 20 and a ring-shaped second protrusion 20b having the same dimension as that of the first protrusion 10a is formed between the opening 20a and the circumference of the second electrode 20.

A flat portion of the outside of the first protrusion 10a of the first electrode 10 and a flat portion of the outside of the second protrusion 20b of the second electrode 20 are referred to as a first flat portion 10c and a second flat portion 20c.

An insulator 11 or an insulation layer is deposited on or attached to an inner area of the bottom surface of the first protrusion 10a. The deposited insulation layer 11 serves to prevent an electric field or an electromagnetic field from being formed between the first electrode 10 and the second electrode 20, when a RF power is supplied between the first electrode 10 and the second electrode 20. Polymide, Teflon, silicon, quartz, or ceramic may be used as the

insulator 11.

Figs. 2 and 3 illustrate the etching of a semiconductor wafer using the electrode of the present invention. Hereinafter, with reference to Figs. 2 and 3, an interaction between the first and the second electrodes 10, 20 of the present invention and the semiconductor wafer 30 is described.

As shown in Fig. 2, the semiconductor wafer 30 is interposed between the first electrode 10 as the anode and the second electrode 20 as the cathode by an electrostatic chuck 40. The electrostatic chuck 40 is installed at a lowering position via the opening 20a of the second electrode 20, thereby bringing the lower surface 30c of the edge of the semiconductor wafer 30 into contact with the upper surface of the second protrusion 20b of the second electrode 20.

A reactive gas is introduced via the gas inlet hole 10b of the first electrode 10 and power is supplied from the RF generator 50 to the second electrode 20, thereby forming an electric field or an electromagnetic field through the first protrusion 10a and the first flat portion 10c of the first electrode 10 and the second protrusion 20b and the second flat portion 20c of the second electrode 20. Then, two types of plasma with different intensity are generated by the reactive gas between the first protrusion 10a and the second protrusion 20b and between the first flat portion 10c and the second flat portion 20c.

Herein, plasma is formed along width of the first protrusion 10a and the second protrusion 20b. The width of the first protrusion 10a and the second protrusion 20b corresponds to the width B of the edge of the semiconductor wafer 30 to be etched. Therefore, an area A of the semiconductor wafer 30, in which fine circuit pattern 31 is formed, is not affected by this plasma. The side surface 30b of the semiconductor wafer 30 is etched by plasma C formed between the first flat portion 10c and the second flat portion 20c.

Since the lower surface 30c of the semiconductor wafer 30 is in contact with the upper surface of the second protrusion 20b of the second electrode 20, the etching is mainly performed on the upper surface 30a and the side surface 30b of the semiconductor wafer 30 by RIE (Reactive Ion Etching).

Further, since the insulation layer 11 deposited on the inner area of the

first electrode 10, an electric field or an electromagnetic field is not formed in the area A, thereby preventing plasma from being generated on the area A and improving the efficiency of the etching.

Herein, reference number 60 denotes a matching network.

As shown in Fig. 3, the electrostatic chuck 40 is elevated via the opening 20a of the second electrode 20, thereby bringing the upper surface 30a of the edge of the semiconductor wafer 30 into contact with the upper surface of the first protrusion 10a of the first electrode 10. Then, the reactive gas is introduced via the gas inlet hole 10b of the first electrode 10 and the power is supplied from the RF generator 50, thereby generating plasma between the first protrusion 10a and the second protrusion 20b. Herein, the etching is mainly performed on the lower surface 30c and the side surface 30b of the semiconductor wafer 30 by plasma, thereby removing the foreign materials deposited on the area B.

Fig. 4 is a cross-sectional view of a vacuum chamber 70, in which the electrode of the present invention is installed. The vacuum chamber 70 comprises a blow pipe 71 for introducing a reactive gas for generating plasma into the first electrode 10 and the second electrode 20, a port 70a for entering the semiconductor wafer 30, an outlet 70b for exhausting the gas after the etching of the semiconductor wafer 30, and the electrostatic chuck 40 for moving the semiconductor wafer 30 upward and downward.

The semiconductor wafer 30 is entered into the vacuum chamber 70 via the port 70a and mounted on the electrostatic chuck 40. Under a reactive gas atmosphere, the RF generator 50 supplies a voltage via the second electrode 20. At this time, the upper surface of the central portion of the semiconductor wafer 30 is protected by the insulation layer 11 of the first electrode 10, and plasma is generated between the first protrusion 10a and the second protrusion 20b and between the first flat portion 10c and the second flat portion 20c. Then, the upper, the lower, and the side surfaces 30a, 30c, and 30b of the edge of the semiconductor wafer 30 are etched through the aforementioned process.

During the etching process, the same as the conventional case, the foreign materials removed from the semiconductor wafer 30 and the reactive gas are

Claims:

1. An electrode for dry etching a wafer, said electrode comprising a first electrode and a second electrode for removing foreign materials from the edge of the wafer by plasma, said first electrode including a first flat plate and a ring-shaped first protrusion corresponding to one surface of the edge of a wafer, and said second electrode including a second flat plate and a ring-shaped second protrusion corresponding to the other surface of the edge of the wafer, wherein said first protrusion and said second protrusion are the same size.

2. The electrode for dry etching a wafer as set forth in claim 1, wherein an insulating material is deposited on or an insulation layer is attached to an inner area of the upper surface of the first electrode, which is inside of the first protrusion.